

# Numeracy Intervention during Pandemic Using Deliberate Practice and Internet-Supported Technology

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**Abstract** This study explored the use of deliberate practice and Internet-supported technology to continue numeracy intervention during a pandemic which limits a face-to-face classroom set-up. This study utilized pre-experimental one-group pretest-posttest research design. Participants were grade 10 students who were considered not numerate using the modified ASER tool, has internet connection within their homes and has the necessary device needed. The numeracy is an 8-week program using the same intervention materials across all students. Results showed significant improvement after the intervention and there were 14 out of 26 students considered numerates based from the modified ASER tool. Additionally, distribution of number of numerates according to grouped-pretest grade tends to be directly proportional. On a survey conducted online using online forms, students generally agree that the numeracy program they participated helped them improve their numeracy skills and conducting it online is appropriate. The conduct of online numeracy is perceived to help them learn while having fun and at the same time helped them become more confident in using technology. However, it must be noted that during the focus – group discussion conducted online, while students generally agree the appropriateness of doing the numeracy online, they were apprehensive of doing it at home because of their poor internet connectivity but will opt to do numeracy program online in school instead of paper and pen.

**Keywords:** action research, mathematics education, ICT tools, teaching intervention, numeracy, teaching strategy

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## 1. Introduction

Learning to read, write and count is critical to a child's success in school and later in life. One of the best predictors of school success is the level of a child's progress in these foundational skills as stipulate in the Philippine's Department of Education Order 12 series of 2015. Further as stipulated on the aforementioned memorandum, the Department finds the important role of strengthening numeracy skills in pursuit of strengthening students' reading skills.

However, from the result conducted in school year 2019 on numeracy skill assessment of Mambuaya National High School (JHS) using the ASER tool, of the 499 students who took the said assessment, 53% belonged to subtraction level which implies that more than half of the respondents has difficulty of performing multiplication and division operations. Further from the said proportion, 23% were from Grade 7, 34% from Grade 8, 23% and 20% were from Grades 9 and 10 accordingly. For the past four years' numeracy intervention had been given to junior high school students with the main objective of improving the number of numerates at the end of the program. While the said program has been successful in

attaining its goal, significant number of students still needs help in improving their numeracy skills.

Numeracy skills does not only produce better assessment results but has also been relevant in the life – long learning process of every individual. In a study conducted, it was evident that people without numeracy skills manifested either early drop – out from school, most of the time without qualification, and had difficulty in obtaining and keeping a full – time job [1]. This is agreed on several research results specifically on influencing students' achievement in the subject mathematics [2,3,4]. Additionally, the importance of developing numeracy skills in early schooling is fundamental for the students to develop as well their skills in understanding simple concepts and will eventually equip them to progress as they proceed to higher mathematics [5]. Likewise, the level of numeracy skill of an individual found to have a strong link in using these skills in practice which is crucial in the multi – dimensional well – being of an individual [6].

The researchers, as classroom teachers as well agree on all these research findings mentioned on how much numeracy skills affects the performance of students in mathematics may it be in performance or written assessments. Through countless experience in classroom scenarios students with poor prior knowledge which

includes poor level of numeracy skills contributes to low participation rate of these said students. Motivating these said students to perform or participate becomes a challenge to math teachers for they lack confidence that they can be able to do any given task in math as they themselves are very much aware of their numeracy skills. As these situations happens in a cyclic manner to a student every school year in a math class because these gaps were not addressed immediately, eventually a student will never be able to appreciate the subject since there was no meaningful learning experience achieved. Thus, the need to give intervention is both beneficial to a student and teacher in such a manner that as these learning gaps are slowly addressed, a student builds confidence slowly, believing that it is possible to achieve in this subject resulting to improve classroom participation and interaction among other students. Likewise, a sense of fulfillment on the part of the teacher will be achieved seeing a student progress because of the intervention at the same time building a better relationship towards that student. In fact, in a Catch Up Numeracy Program conducted, results revealed that students' "arithmetical difficulties" is greatly influenced by interventions conducted by a teacher [7] which further supports the need to provide an intervention as significant number of students are struggling on their numeracy.

However, this pandemic becomes a challenge in how to continue the numeracy program that the school has been implementing. While this pandemic prohibits the students to come to school, the program owners desire to continue the implementation of its intervention program. Thus, modification of its approaches will be implemented such that internet supported technology will be maximized during this no "face-to-face" classroom instruction.

Additionally, designed learning environment with a purpose of providing meaningful learning experience must be target-specific to the skills associated in a learning outcome. According to Gilmore et al., [8], there are at least three groups of cognitive skills that can be associated in learning outcomes in mathematics, procedural and conceptual skills are specific to mathematics outcome while working memory which is the third is a domain general.

Procedural skill is the ability to carry out a sequence of operations accurately and efficiently [9] or knowing how-to [10] this implies that strengthening procedural skills strengthens numeracy skills since the numeracy skills measured particularly in this program pertains to carrying out sequence of operations accurately by adding, subtracting, multiplying and dividing. Working memory and procedural skills are strongly associated compared to conceptual skills [11] since the role of working memory in mathematics performance can be, but not limited to storing of interim solutions and accessing stored information in the long-term memory [8]. Moreover, learning happens when information from working memory is transferred to long-term memory that is, the information is retained - and practice can help this process [12] hence deliberate practice is necessary to strengthen procedural skills. Deliberate practice as defined by Ericsson et al. [13] is a specially developed activities repeatedly pursued by students with feedback from a teacher (expert). Anchoring from both the learning skills associated in learning

outcomes in mathematics and deliberate practice, the numeracy program will then focus on strengthening the procedural skills of performing the fundamental operations through deliberate practice as procedural skill has been established to be strongly associated in keeping information in the long term memory and long term memory is associated with retention which is the capacity to remember learned skill or knowledge for a longer period of time. Considering the pandemic situation as well that limits the face to face classroom set-up, internet supported technology will then be utilized to be able to implement the said program. It is with this reason that this research aims to conduct a numeracy intervention program designed to improve the number of numerates. More so, the research also aims to uncover the overall performance of students and their perception towards the intervention program.

## 2. Methodology

### 2.1. Research Design and Sampling

This research utilized a pre-experimental one-group pretest – posttest research design. This research design is used when a single group is observed at two observation times, one before the treatment while the other is after the treatment, and where the changes in the outcome are presumed to be the result of the intervention [14]. The participants were the identified through a purposive sampling that is, they are grade 10 students, having the capacity to participate fully such that there is an availability of the device needed and good internet connection.

### 2.2. Implementation

Due to this pandemic all the activities were done online. Pre-test was given to all grade 10 students at the start of the program to identify their numeracy level using ASER tool. From the pretest result, the participants were then selected. Pre – selected participants were those who were not able to get 100% score or perfect score on the pretest using the ASER tool. The program was implemented on the following manner: there are four fundamental operations in math thus there were four levels. Level 1 is for addition, level 2 subtraction, level 3 multiplication and finally level 4 is division. Ten practice activities with specific test codes for every level was given to the participants in which they were able to do repeatedly (deliberate practice) until such time that the percentage score will be at least 80% to proceed to the next task. After all the ten (10) practice tasks were completed in a certain level an assessment called "checkpoint" was given to assess if the student can proceed to the next level, the student must be able to get at least 80% each on the two given assessment tasks. It must be noted that the program is designed on a progression manner thus all identified participants started from level 1, addition, to the final level 4, division. Additionally, it was also designed in such a manner that student were able to self – paced themselves. This means that every student determines the time in a day to perform the activities, how much time allocated as well

as how many days in a week it was done. Weekly online feedback was done either through online form or messages to monitor their progress. Supplemental videos that used local dialect in explaining were provided for every level in which they were able to access anytime through a video channel of one of the researchers whenever a student needed more assistance. When the student completed the final level, division, posttest will be given. Every student who got 100% on posttest will be considered numerate.

### 2.3. Data Gathering Methods

Pretest and posttest results were gathered from a free learning management system used in this study, thatquiz. Online form was used to gather data on student' perception on the numeracy program specifically on its capacity to help them improve their numeracy skills and their entire experience doing numeracy program online. Focus group discussion is done as well online using MS Teams since students have been provided by DepEd their Office 365 accounts

### 2.4. Data Analysis

A paired t – test was used to determine significant improvement of the over – all performance of the group after the intervention [15,16]. Posttest results were used to determine who are numerates at the end of the program. All who got 100% or perfect score on their posttest will be considered numerates. Teacher – made Likert scaled perception survey results was consolidated using mean and standard deviation.

### 2.5. Research Ethics

This research is implemented with its full adherence on observing research ethics thus student assent and parent's permit is given to the concerned participants. While the whole duration of the entire program is done online researchers are aware that these students will be protected from any threat the whole time thus participants are oriented on the etiquettes and the house rules they must observe during online sessions. Data privacy is also given utmost considerations thus every students' work is password protected. Internet supported technology sources used specifically on the conduct of the program are ensured to be sources that meet the data privacy standards.

## 3. Results and Discussions

### 3.1. Effect of Intervention Program on Student's Overall Performance

The effect of the numeracy intervention program on student's overall performance is shown in [Table 1](#). A paired t-test is used to determine the significant difference in the pretest and posttest scores [17]. There were twenty – six grade 10 students out of 152 who were able to complete the 8 – week program which is only 17% of the entire population of grade 10. An increase of the mean pretest and posttest scores and the decrease of the standard deviation respectively showed a significant

improvement of their performance not just as a group but individually as well with respect to the significant mean increase using t – test result. This implies that each of the student benefited on the numeracy program in terms of improving their skills on the four fundamental operations of addition, subtraction, multiplication and division.

**Table 1. Paired t – test of two sample mean overall performance**

	Pretest	Posttest
Mean	85.54	97.88
SD	11.01	2.85
Observations	26	26
p - value	0.000*	

\*Significant at 0.05 level.

There were 14 (54%) out of 26 who were considered numerate at end of the program using the ASER tool. The number of numerates increases as grouped-pretest grade increases. This implies that in a given uniform duration of intervention with the same intervention materials the disparity will still be evident between classified students. Though every student had significant improvement after the intervention the level of improvement is different according the level of their prior knowledge. There could be a variety of factors that contributes to this disparity and providing students the same intervention materials as well as length of time to complete the intervention are included. This is somewhat in similar situation as giving different people with different resources in accomplishing exactly the same task. The task will most likely be accomplished but the manner and quality of result will greatly depend on the available resources they have both internal and external resources. Since student have different level of prior knowledge based from pretest result, each has different ways of how to accomplish it given that duration and intervention material is the same. Prior knowledge can be considered as an internal resource which contributed to their posttest results which is supported on several studies on the relationship between prior knowledge and learning outcomes in mathematics [18,19,20].

However, researchers also found out during the focus – group discussion that some of the student felt somewhat pressured because of the timer. In the learning management system that was used for this intervention, the system provides an option to a teacher in designing a test to put a timer or not. The numeracy program was designed to have timer to all activities and tasks in order to acquire other data for future endeavors unfortunately, it somehow contributed pressure to some while accomplishing each task. It must be noted that timer and time limit are two different terms on this study. Timer provides information on how long the task was completed while time limit is the length of time the task must be completed. All practice activities except addition and subtraction do not have time limit but only a timer. The researchers designed addition and subtraction to have time limit for the purpose that they will be more challenged to do the task since identified skills that they were having difficulty were regrouping in subtraction and remainder in division using the ASER tool, researchers anticipated that these two levels (addition and subtraction) except for regrouping in subtraction will be very easy. In the focus –

group discussion and weekly feedbacks it was confirmed that those two levels identified were easy to perform, unfortunately, because of the time limit inserted on addition and subtraction activities, some of the learners assumed that multiplication and division activities were also set to a time limit.

### 3.2. Student's Perception towards the Numeracy Intervention Program

The perception of students on how helpful the numeracy program they participated validates further the significant improvement from pretest to posttest after the intervention. How the program is perceived by the students affects their performance as well. A positive perception towards the capacity of the program to help them will result to a positive learning outcome. Table 2 shows result of student's perception on the capacity of the program to help improve their numeracy skills and on how their numeracy skills were improved after the program. Generally, the numeracy program was perceived to help students improve their numeracy skills. As mentioned, regrouping in subtraction and remainder in division are one of the target – specific skills that this program was designed to address. Based from the result, students agree that because of the numeracy program they become more confident on performing those operations that involved those two skills mentioned.

Consistently, they all agree that the program helped them improved on the level where they were having difficulty. Additionally, they agree that the program helped them practice more the skills they learned which they tend to forget because it seems like it is not used on their high school math. Furthermore, this result was verified during the focus – group discussion as they realized that they did forgot some of the skills which was measured on the ASER tool but somehow recalled it as they were provided more practice activities and videos to provide assistance. Prior knowledge depends on how much learning is retained on the previous lessons thus storing skills or knowledge learned on the long – term memory is very important to happen, and as Gilmore et. Al [8] have mentioned procedural skills and long – term memory has strong association to each other. This

implies that the design of the program was able to help them improve their prior knowledge that is being measured, through doing deliberate practice of the materials designed by the teachers targeting specific skills to improve.

### 3.3. Student's Perception towards Using an Online Platform for the Intervention Program

The perception of students on doing the numeracy program online is shown in Table 3. Overall, online numeracy program was perceived to be appropriate. The integration of internet supported technology using different platforms to implement the program and monitor students' progress was an enhanced approach to provide numeracy intervention this pandemic. It is important that they feel comfortable on the learning environment designed, to obtain the learning outcome expected. The feeling of students towards their learning environment affects the success of their learning process [21]. Thus, perceiving online numeracy program as appropriate for them motivates them to continuously pursue to complete given tasks. By doing the program online they were able to self – paced themselves within the 8 – week duration making it more favorable since they can choose which time of the day they are at their best to perform assigned tasks, this can be supported by the study of Magagula et.al [22] which mentioned that one of the advantages of distance learning is be able to study in own pace, time and place. The program also allows them to manage their time accordingly as they intended it to be since aside from participating on this numeracy program, they are still expected to accomplish modules on other learning areas. Aside from that, students also agree that this online numeracy program helped them improve their confidence in using technology. The frequent use of their device and increase access on platforms used on this program enables them to learn new skills that they were not able to discover in a conventional classroom set-up. Learning how to use an application like the learning management system, thatquiz, MS Teams and online forms allows them to discover certain procedures that will be very helpful when accessing new applications.

Table 2. Student's Perception on Numeracy Program towards Improving their Numeracy Skills

Indicators	Mean	SD	Description
The numeracy program helps me improve my numeracy skills.	3.40	0.51	Strongly Agree
This numeracy program must continue because it is helpful to us students to improve our numeracy skills.	3.27	0.46	Agree
This numeracy program helps me realize that practice is very important to avoid forgetting skills I learned like how to add, subtract, multiply and divide.	3.33	0.49	Agree
The numeracy program is able to help me improve on the level where I find I was having difficulty.	3.33	0.49	Agree
After participating in the numeracy program, I feel more confident to perform addition, subtraction, multiplication, and division.	3.33	0.49	Agree
This numeracy program helps me perform addition, subtraction, multiplication and division with correct answer.	3.27	0.46	Agree
This numeracy program helps me perform subtraction in more than two digits with borrowing faster with correct answer.	3.20	0.56	Agree
I am confident to perform multiplication correctly in more than two digits because of the numeracy program.	3.07	0.46	Agree
I am confident to perform division correctly in more than two digits with remainder because of the numeracy program.	3.07	0.26	Agree

**Table 3. Student's perception towards online delivery of numeracy intervention program**

Indicators	Mean	SD	Description
It is good that the numeracy program is done online.	3.00	0.65	Agree
Because the numeracy program is done online, I can choose on what time of the day I will do my tasks.	3.14	0.36	Agree
Doing my numeracy activities online is easy because the procedure to access my activities is easy.	3.00	0.39	Agree
Doing numeracy program online helps me track my performance immediately since it will give result after I finish answering my tasks.	3.07	0.73	Agree
I prefer joining numeracy program answering online instead of answering using paper and pen.	2.50	1.02	Disagree
By doing numeracy program online, I find it also very helpful to improve my confidence in using technology.	3.14	0.36	Agree
I can learn more on numeracy program through online approach.	2.93	0.27	Agree
I enjoyed doing my numeracy tasks online.	3.07	0.27	Agree
I have fun doing my numeracy tasks online while learning.	3.14	0.36	Agree
Doing numeracy online allows me to do it at home on my own and so I do not have to be conscious on how I perform compared to others like doing it inside the class.	3.14	0.36	Agree

Additionally, students enjoyed doing the numeracy program online and most importantly they were able to have fun accomplishing the tasks while learning the targeted skills. However, result showed disagreement on the preference of continued implementation of numeracy program online, this data was validated during the focus – group discussion. It was found out that they do not prefer an online numeracy program at home because of poor internet connectivity, but if the online numeracy program will be done in school, they will prefer it rather than doing the paper and pen method. This clearly shows how internet connectivity must also be considered in implementing an online numeracy program as it affects not only the preference of the students to access the program but their performance in accomplishing given tasks as well.

On the part of the researchers, as classroom teachers, the need to provide intervention and the manner on how it must be implemented in such a way that it can be sustained while assuming other tasks are some of the considerations taken. In the past four years, the program has tried to make use of paper and pen method but along the way, it was difficult keeping up checking their activities on time due to some other tasks that comes in between. Immediate feedback is an essential part in providing an intervention as this affects students' motivation to continue pursuing the program. Researchers found online numeracy program to be an appropriate approach which will provide math teachers a better way of implementing the numeracy program. Online numeracy program can make the implementation asynchronous lessening time, effort and attention from the teachers. Teachers will be more focused on monitoring the progress and providing the needed assistance of each students. This implementation also helps students to be exposed to different kinds of technology which will eventually improve some of their 21<sup>st</sup> century skills.

#### 4. Conclusions and Recommendations

The implementation of the 8-week numeracy program using deliberate practice and internet supported technology was able to help students improve their numeracy skills. The intervention showed significant improvement from pre-test to post-test as well as its

capacity to yield numerates at the end of the program using ASER tool as basis. The level of improvement is different according to the level of their prior knowledge. Students perceived the implemented numeracy program to be helpful in addressing their difficulty on skills included in the numeracy program and the conduct of online numeracy program is highly favored as long as there is good internet connectivity instead of paper and pen method.

However, based from the results of this study, as this online numeracy program progress the inclusion of timer in their practice activities should be taken into consideration. Should the timer be included it must be clear to the students its very purpose to avoid confusion. Additionally, to address level of improvement disparity among students, it is of great interest to explore implementing the program with unbounded time as well as to maximize its capacity to yield number of numerates at the end of the program.

Literacy and numeracy both are concerns that Mambuaya National High School intended to address thus, the school plays an important role in providing the necessary resources to achieve the goal. This implies that as online numeracy program has been found to be helpful and appropriate for both students and teachers, school ICT laboratories will be maximized for it to continue.

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